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ABSTRACT

The CEO Forum on Education and Technology is an alliance of CEOs of leading United States corporations and educational organizations, all committed to a four-year project to annually assess and help improve America's program on integrating technology into its classrooms. Since the Year 1 report (1997) was issued, there has been solid progress integrating technology into public K-12 schools--the number of schools effectively using technology has risen from 15 to 24 percent, and almost 80% of schools have connections to the Internet. Focusing on professional development, this report provides: an overview of efforts to prepare teachers to use technology to improve education; a description of the progressive stages educators pass through as they integrate technology into teaching and learning; a list of essential principles for developing successful plans for professional development with technology; information and practical advice about how to make the most of technology in schools and classrooms; and a summary of the Year 2 STaR (School Technology and Readiness) assessment of current statistics in these four "pillars" of educational technology: hardware, connectivity, digital content, and professional development. The Year 2 methodology and the CEO Forum four year agenda are also provided. (AEF)

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The CEO Forum

School Technology and Readiness

Professional Development: A Link to Better Learning

Year Two

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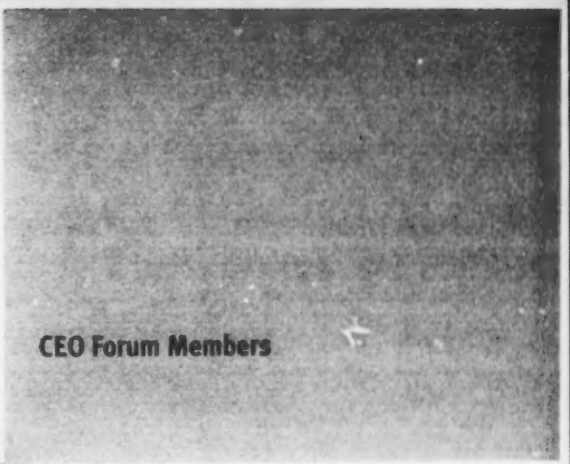
The quality of public education in this country increasingly depends upon our collective ability to close the gap between technology presence and its effective use in the pursuit of school improvement.



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Letter from the CEO Forum

Since we issued our first report, "*The School Technology and Readiness Report: From Pillars to Progress*," in October 1997, there has been solid progress integrating technology into America's public K-12 schools. As our Year 2 School Technology and Readiness Assessment shows, the number of schools effectively using technology has risen from 15 to 24 percent. In addition, almost 80 percent of schools have connections to the Internet.

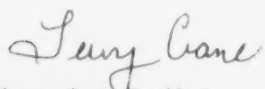
This progress is encouraging. Nevertheless, the gap between technology presence in schools and its effective use is still too wide. We continue to believe the quality of public education in this country depends upon our collective ability to close the gap between technology presence and its effective use in the pursuit of school improvement.

Anecdotal evidence suggests that appropriate use of technology has a positive impact on education. Nevertheless, broad-based statistical analysis of the impact of technology in education remains elusive.[1] Our nation is now reaching a stage in which the prevalence of and access to technology is at a threshold level in a significant number of schools. Therefore, we must direct our attention to the use of technology in schools and its impact on student performance.

Bolstered by a recent study that shows a positive correlation between student performance and teacher professional development[2] and on our steadfast belief that teachers are a critical link to better learning, this report provides:

- an overview of existing efforts to prepare teachers to use technology to improve education;
- a description of the progressive stages educators pass through as they integrate technology into the process of teaching and learning;
- a list of principles we believe are essential for developing successful plans for professional development with technology;
- information and practical advice about how to make the most of technology in schools and classrooms; and
- a series of recommendations to help ensure that teachers are well prepared to guide today's students to future success.

We hope the report is helpful and that from it, educators find support, inspiration, and some great ideas they can put to work in their schools. We also hope it prompts decisive action to empower teachers to take advantage of technology as a tool to improve education and student performance.



Therese Crane, President
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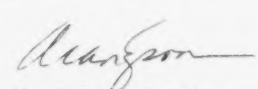

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The Washington Post Company
Co-Chair, CEO Forum

Year 2

Highlights

- During the last year, the number of computers in American schools has increased 13% to create an installed base of six million computers.
- The number of schools effectively using technology has increased to include almost one quarter of the nation's schools.
- Almost 50% of schools have Internet connections.
- More than 50% of American schools remain in the Low Tech readiness category.

Recommendations

This report builds a strong case for better preparing new and veteran teachers to use technology more effectively to help students achieve higher academic standards and to improve education generally. To reach these goals, the CEO Forum recommends the following actions by educators, administrators, and business and community leaders. We realize the recommendations are ambitious, but with community-wide commitment, a national imperative, and adequate support

1 Schools of Education should prepare new teachers to integrate technology effectively into the curriculum.

- National accreditation standards for schools of education should be changed by 2000 to require that schools of education prepare new teachers and administrators to integrate technology into the classroom.
- Schools of Education should provide faculty with the tools, incentives, and on-going professional development they need to integrate technology into the teacher-training curriculum by 2001.
- New teacher and administrator licensure and certification programs should require proficiency in integrating technology into the curriculum by 2003.
- Technology funding for schools of education should be increased.

2 Current teachers and administrators should be proficient in integrating technology into the curriculum.

- Every state should develop standards for effective continuing education on integrating technology into the curriculum by 2000.
- Schools and districts should establish long-term technology related professional development plans and proficiency standards for all teachers and administrators by 2000.
- Every teacher and administrator should have ready access to appropriate communications and information technology.
- Resources for technology-related professional development should be increased.
- Every professional development program should integrate technology as a part of all training components.

- Almost 24 million American households have a personal computer, and e-mail access has increased by 400% over the last three years.
- Sixty percent of the jobs available at the beginning of the next century will require skills currently held by only 20% of the workforce.
- K-12 schools are likely to hire two million new teachers over the next decade to fill vacancies left by retiring teachers and to accommodate increasing student populations.
- Only 20% of teachers report feeling very well prepared to integrate education technology into classroom instruction.
- Our public education system must do more to prepare students for life and work in a world heavily dependent on the use and application of technology.

at all levels, they can be achieved. • In addition to the following recommendations, the CEO Forum continues its call for new data on the integration and use of technology in our nation's schools. Only then will education technology researchers and analysts have the information they need to conduct broad-based evaluations of the impact of appropriate technology use on student achievement and school performance.

3 Education policymakers and school administrators should create systems that reward the integration of technology into the curriculum.

- Hiring standards for teachers and administrators should include technology integration proficiency by fall 2000 and they should be mandatory by 2002.
- Policymakers and education administrators should make a commitment by 2000 to advocate for technology-inclusive professional development as a means to ensure teacher and student success in the classroom.
- Performance evaluations for in-service teachers and school administrators should encourage and reward technology integration and innovation by 2000.
- Subject-based curriculum standards and measurements should include appropriate technology integration components by 2002.
- Student performance assessments should capture the educational benefits enabled by technology by 2002.

4 Corporations and local businesses should collaborate with the education community to help ensure that today's students will graduate with 21st century workplace skills.

Corporations and local businesses should:

- Collaborate with schools of education and K-12 schools to provide support and share relevant best practices for integrating technology.
- Implement technology leadership seminars for principals and school administrators.
- Provide leadership and guidance on skills requirements that exist in their workplaces and provide information to help define and continuously refine a K-12 curriculum to support the development of these skills.
- Work with colleges of education to clarify goals and objectives for continuous faculty professional development that encompasses technology and to ensure availability of adequate resources.

Section I

Professional Development: A Link to Better Learning

To thrive in today's world and tomorrow's workplace, America's students must learn how to learn, learn how to think, and have a solid understanding of how technology works and what it can do. Teachers hold the key. In fact, teachers are perhaps the single most important factor determining the quality of education.

Overview

Technology availability is improving. During the last year, the number of computers in American schools increased 13 percent to create an installed base of 6 million computers.[3] While the increase is encouraging, it is important to note that the technology available outside school walls is often several generations ahead of the technology available inside school walls. For example, at 14:1, the student-to-computer ratio for "top of the line" machines is twice as high as the national average student-to-computer ratio for less sophisticated machines.[4]

However, more schools than ever before are connected to the Internet. In three years, from the fall of 1994 to the fall of 1997, the percentage of U.S. public schools with Internet access increased from 35 percent to 78 percent.[5] The number of schools with five or more classrooms with Internet access increased from 25 percent of all schools in the fall of 1996 to 43 percent of all schools in the fall of 1997.[6] During 1997 and 1998, schools spent an average of $30.98 per student on Internet services and are expected to increase that spending

The real strength of technology in education comes from using the right technology at the right time to meet the right objective.

to $32.13 per student in 1998-1999.[7]

These are commendable signs of progress. Nevertheless, the transformation of classroom technology from hardware, software, and connections into tools for teaching and learning depends on knowledgeable and enthusiastic teachers who are motivated and prepared to put technology to work on behalf of their students.

Technology in School: An Opportunity for Improvement

As technology becomes more prevalent in schools across the country, expectations for corresponding improvements in education grow as well. Technology is not a panacea for the challenges facing the education community. However, we believe that when used appropriately, it can be an effective tool for promoting practices shown to improve student achievement and school performance.

For instance, when used to teach higher-order thinking skills in middle schools and for learning games in elementary schools computers can have a positive effect on student learning.[8] Appropriately applied technology facilitates and reinforces project-based learning by allowing students to work together to research, analyze, and solve problems creatively. Some believe that drill and practice software can be effective in improving fluency of basic skills and

Moving from Traditional to New Learning Environments[9]

Traditional Learning Environments	New Learning Environments
Teacher-centered instruction	Student-centered learning
Single sense stimulation	Multisensory stimulation
Single path progression	Multipath progression
Single media	Multimedia
Isolated work	Collaborative work
Information delivery	Information exchange
Passive learning	Active/exploratory/inquiry-based learning
Factual, knowledge-based	Critical thinking and informed decision making
Reactive response	Proactive/planned action
Isolated, artificial context	Authentic, real-world context

SOURCE: INTERNATIONAL SOCIETY FOR TECHNOLOGY IN EDUCATION (ISTE) NETS PROJECT. NATIONAL EDUCATIONAL TECHNOLOGY STANDARDS FOR STUDENTS, JUNE 1998.

"Access to and use of information technology, particularly in educational settings (K-12 as well as higher education), is a prerequisite to building the skills base that will allow our citizens to function productively in the information society of the next century."[14]

Today's Technology-Rich Society

- Almost 40 million American households have a personal computer.[15]
- E-mail access has increased by 400% in the past three years.[16]
- By the end of January 1998, there were close to 30 million Internet hosts.[17]
- By 2001, the U.S. Internet economy is projected to total more than $350 billion.[18]

in reinforcing concepts already learned. Many also believe that computer simulation software helps to engage students in the process of learning by enabling them to visualize the lesson or theory and to present complex information in simple formats. However, when not used appropriately, technology can have a negative impact on student performance.[19] The real strength of technology in education comes from using the right technology at the right time to meet the right objective.

Experts have long recognized that educating students includes more than classroom learning. In today's society, educating students extends beyond school walls and requires cooperation among schools, parents, health care, and other service providers. Computer and communications technologies, from simple e-mail capabilities to complex service referrals, provide convenient and effective avenues to bolster cooperative efforts necessary to meet the unique needs of a diverse student population.

The bottom line is clear: technology, applied well, can enhance and reinvigorate education, making schools richer and more exciting interactive communities of learning for students and teachers alike. We must do more, however, than put technology in schools; we must empower teachers to use it effectively.

New Urgency

Securing a positive return on rising national investments in hardware and connectivity requires a heightened focus on how these resources are used.[20] Unfortunately, it is difficult to measure "use" of resources in public schools. It is clear, however, that teachers and administrators cannot ensure effective and appropriate use of technology without effective and appropriate training and education.

Available data on computer training, which is only the most basic component of overall technology training and education for educators, suggests that the news is not good. In 1998-1999, schools project they will spend $5.65 per student on computer training of teachers. In comparison, schools expect to spend $88.19 on instructional hardware, software, and connectivity in 1998-1999.[21] Matched against the Department of Education's recommendation that schools allocate at least 30 percent of their technology budgets to professional development,[22] current spending is inadequate.

Current Teachers

Preparing the roughly three million teachers at work in our public schools to use technology effectively is not a priority in terms of spending or practice today. It should be. These teachers are responsible for preparing today's students for life and work in a world heavily dependent on the use and application of technology.

Members of the public most often cite job readiness as a primary factor in deciding whether computers and technology are effective in education.[23] There is good reason to do

so. In a recent study, the U.S. Department of Labor identifies the 54 jobs with the highest growth potential between now and the year 2005 and only eight do not require technological fluency. None of the eight currently pays more than twice the minimum wage.[5] Moreover, it is estimated that 60 percent of the jobs available at the beginning of the next century will require skills currently held by only 20 percent of the workforce.[6] In addition, the demand for workers to fill higher-skilled information technology jobs is likely to grow from 874,000 in 1996 to 1.8 million in 2006.[7] Finally, higher skill jobs have higher wages. Overall, compensation in elite jobs grew 2.5 times faster than compensation in blue-collar occupations, and 4.3 times faster than in service occupations between 1987 and 1996.[8]

More than ever before, employers in all industries are demanding that their employees have basic technology skills and skills enabled by the use of technology. As far back as 1991, the Secretary of Labor's Commission on Achieving Necessary Skills (SCANS) articulated five areas (see sidebar) in which students must be competent, and therefore schools must teach, for the future.[9] Today, the skills most often called for are essentially the same: that students are technologically fluent, that they learn how to learn, and that they can use technology to communicate, collaborate, and support critical thinking and creative problem solving.[10]

K-12 schools play a fundamental role in educating our workforce and their importance will only increase as the economy becomes more dependent on increased skills and education.[11] Ours is technology-rich society. America's public education system, therefore, has a responsibility to provide students with the skills and knowledge employers demand. Professional development for teachers and administrators that focuses on continuous improvement and encompasses technology integration is a critical link to ensure that learning.

Future Teachers

Better preparing teachers is not a challenge that begins with the teachers already in the classroom; it begins earlier. Over the next decade, K-12 schools are likely to hire roughly two million new teachers[12] in part to fill vacancies left by retiring teachers and in part to accommodate an increase in the student population. Nevertheless, America's schools of education have only just begun to focus on preparing their students — these future teachers — to understand, access, and bring technology-based experiences into the learning process. For example, most student teachers enrolled in education programs in the U.S. neither routinely use technology during field experience nor work under master teachers and supervisors who can advise them on the use of information technology.[13]

The challenge is further complicated because the faculty at teacher colleges fre-

From the SCANS Report: Necessary Skills for Students

- Identify, organize, plan, and allocate resources;
- Work with others;
- Acquire, organize, use, maintain, interpret, communicate as well as use technology to process information;
- Understand complex inter-relationships and systems; and
- Work with and apply a variety of technologies to complete tasks.

Teachers today need ongoing exposure to technology and the resources required to turn the possibilities technology offers into real results for students at all levels and in all disciplines.

quently lacks the skills and experience necessary to turn technology into an effective teaching tool for themselves and a learning tool for their students. In fact, most faculty members do not model use of information technology skills in teaching."

While this report begins to address the issue of technology education at teacher colleges, it is by no means comprehensive. More work is necessary to address the specific needs and unique role these institutions should play in boosting education technology understanding and effective use.

Technology Professional Development: Critical Throughout A Teacher's Career

Due to the unprecedented presence and prevalence of technology in society, it is no longer sufficient, or perhaps even appropriate, to talk about "technology training" as a goal in education. Educators need much more than intermittent sessions on how to operate computer equipment and software.

Teachers, like all professionals, need and deserve ongoing exposure to technology so it becomes a seamless component of instruction that leads to real results for students. They need professional development.

Professional development for teachers is an ongoing, long-term commitment that begins with the decision to pursue a career in education and continues, through a combination of formal and informal learning opportunities, for the duration of a career.

To become a teacher in our nation's public schools, one typically must follow a three-step path: 1) the pre-service program; 2) initial licensure and periodic license renewal; and 3) in-service career development.

Pre-Service Programs

Definition: The professional preparation of teachers has traditionally occurred through four- or five-year programs administered by colleges of education at institutions of higher education. These programs typically integrate the study of subject matter, student development, and teaching methods. They usually also include a supervised clinical experience — often referred to as "student teaching" — where aspiring teachers work in K-12 classrooms under the guidance and supervision of experienced teachers. Teacher preparation programs generally are accredited by the National Council for Accreditation of Teacher Education (NCATE), the national professional accrediting organization.

Status: Now more than ever before, schools, colleges, and departments of education in the United States are beginning to address the challenge of pre-service professional development in technology and technology use. This heightened attention is critical. The benefits of strong teacher preparation programs extend beyond the pre-service teachers they educate. In addition to improving how well students are pre-

pared, well-prepared new teachers share their knowledge with colleagues, model best practices, and motivate other teachers to teach with technology.[50] Yet, while most teacher education institutions report that their technology infrastructure is at least adequate to carry out their current programs, about one third still believe deficiencies in their facilities limit their programs.[51]

More than 70 percent of teacher preparation programs require three or more credit hours of instruction in courses focused on technology. About fifty percent of that instruction is part of other classes such as methods and curriculum courses. Importantly, these integrated instructional hours more positively correlate with technology skills and the ability to integrate information technology than do stand-alone information technology courses.[52]

Despite the fact that the information technology skills of faculty members at teacher colleges are today comparable to their students' skills, most faculty members do not model the use of information technology skills in their teaching.[53] Modeling teaching styles, however, is often considered an effective method of conveying new skills.

The best chance to achieve results is to develop a long-range plan with pre-defined, widely endorsed goals and objectives, including the necessary resources. Nevertheless, schools of education tend to lack written, funded, and regularly updated technology plans.[54]

Initial Licensure/License Renewal

Definition: Teacher licensure is a regulatory function of state government that assures the public that beginning teachers have met specified requirements to practice their profession. Standards for initial licensure vary from state to state, but usually include a combination of degree requirements as well as age and citizenship requirements. Initial licensure standards in all states include the requirement that teachers are prepared in state-approved programs, and 70 percent require clinical experience.[55] Nearly all states require teachers to maintain or renew the validity of their licenses through some form of continuing education or staff development. However, standards for licensure renewal vary widely with respect to the interval for renewal and the approved methods of meeting the requirements (college courses, district workshops, conference attendance, etc.)

Status: Today, 41 states and the District of Columbia require professional development for licensure and 25 states require "computer education" for initial licensure.[56] The National Council for the Accreditation of Teacher Education (NCATE) has recognized the importance of preparing teachers to use technology to achieve higher academic standards. NCATE has issued a series of technology-related curriculum guidelines that schools of education must meet before they receive accreditation.[57]

A Step in the Right Direction: National Accreditation Guidelines[58]

- Students complete a sequence of courses or field experiences, which allows them to understand technology as it relates to the subjects that they plan to teach.
- Students understand how to use technology for instruction, assessment, and other professional reasons.
- Faculty members know about current technology-related practices and use them in their teaching and scholarship.
- Faculty members and students have access to and training in a number of educational technologies.
- Institutions provide, maintain, and support computing, communications, and instruction technology at least at the level they do in their other schools or programs.

For more information visit www.ncate.org

This is a critical step in the right direction. Approximately one third of schools of education that produce two thirds of the country's new teachers are NCATE accredited and, therefore, must meet these standards.

States can help ensure that technology-related proficiency standards become a priority in licensing and license renewal procedures in the 21st century. Of the states that have standards for teacher technology preparation, however, only two (North Carolina and Vermont) require teaching candidates to have a portfolio that shows they can use technology.[59] Though many states provide professional development opportunities for teachers, only three require participation in technology training as a prerequisite for license renewal and only 14 require districts to spend a certain percentage of technology funds on professional development.[60]

A survey recently conducted by *Education Week* finds that every state has a policy plan for education technology and is appropriating funds. Unfortunately, few are addressing continuing inequities among schools in their states or setting requirements for student and teacher proficiency.[61] Furthermore, while every state has a technology plan, few have taken the extra step to determine the cost of implementing the plan.[62] A clear spending plan directed toward reaching specific goals is essential.

It also is essential to collect more data about technology use in schools. Today, data collection varies widely from state to state. Without better data on how schools are using technology, it is difficult to assess the impact of technology. An inability to assess the broad impact of technology hampers the ability to make the case for fully funding and implementing technology plans.

In-Service Career Development

Definition: States and school districts must make substantial investments to ensure continuous teacher learning and skill acquisition. The most effective in-service career development activities focus on providing instruction in order to improve student learning. They are site-based, rigorous, sustained, and designed and directed by teachers. Equally important, they balance individual priorities with school and district needs.

Status: Technology is an instrument for achieving the ultimate goals of high academic standards and improved school performance. Therefore, schools should incorporate appropriate professional development with technology at every opportunity. Although many educators and policy analysts consider educational technology a vehicle for transforming education, only 20 percent of teachers feel well prepared to integrate education technology into classroom instruction.[63]

The unique ability of technology to enhance the professional performance of teachers and thereby the performance of stu-

"What teachers really need is in-depth, sustained assistance as they work to integrate computer use into the curriculum and confront the tension between traditional methods of instruction and new pedagogic methods that make extensive use of technology."[44]

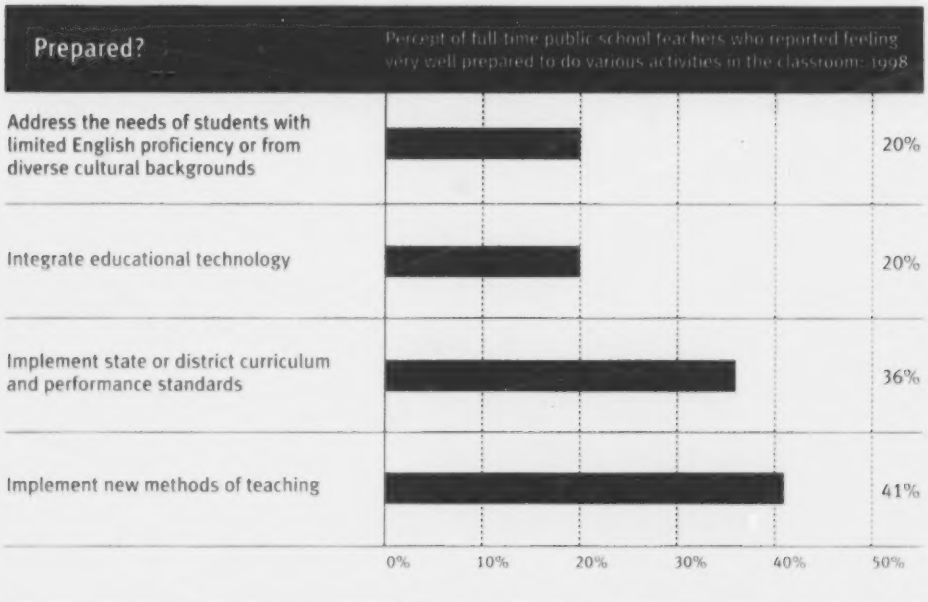
dents and institutions makes it imperative that teachers learn to "teach *with* technology, not just *about* technology."[45] The CEO Forum believes that by combining the best of traditional learning with the unprecedented information and resources made available through technology, teachers can better prepare their students to succeed.

In-service professional development for educators increases knowledge, reinvigorates teaching, and in many cases, inspires change in teaching practices. Technology-related professional development enables teachers to employ an important tool with value across disciplines and in all departments. Although our focus in this report is almost exclusively on teaching and learning in the classroom, the use of technology impacts administrative and student service functions as well. For schools to accomplish the transformations demanded by 21st century global competition, the application of technology, and hence the development of competent professionals, should cut across all school operations.

A few examples demonstrate the magnitude of potential time saved from adopting even the most basic technology. Consider, for example, a junior high school in Richardson, Texas that installed telephones in classrooms so teachers could reduce time walking through hallways to

States Requiring Computer Education for Licensure

Alabama, Alaska, Arizona, California, District of Columbia, Kansas, Kentucky, Maine, Massachusetts, Michigan, Missouri, New Hampshire, New Mexico, North Carolina, Ohio, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Washington, West Virginia, Wyoming.



SOURCE: U.S. DEPARTMENT OF EDUCTION, NATIONAL CENTER FOR EDUCATION STATISTICS, FAST RESPONSE SURVEY SYSTEM, TEACHER SURVEY ON PROFESSIONAL DEVELOPMENT AND TRAINING, 1998

Since teachers are the linchpins of success for students, their individual requirements for mastering new methods, knowledge, and techniques deserve particular attention.

A New Way to Discuss Professional Development

Sue Bastian was tired of sitting through presentations. As President of Teaching Matters, a non-profit organization providing technology training for New York City teachers, she longed for a new way to engage her team in discussions about professional development. She found it in "New Thinking, New Teaching," a play written and performed by the Teaching Matters staff. The play shows both the challenges and opportunities a school encounters as it seeks to integrate technology into the classroom. Designed for teachers and administrators alike, the play is a comical way to address the serious issues schools face in their quest to improve professional development. For more information on Teaching Matters, visit its web site at www.tminet.org

communicate. This simple change saved teachers approximately 15.5 days of time each year.[66] In another school, River Oaks outside of Toronto, Ontario, the principal adopted a practice of conducting all logistical communications with his staff via e-mail, thus eliminating the need for administrative discussions in staff meetings. Consequently, River Oaks reduced bi-weekly meetings of 90-100 minutes to three staff meetings per year. This simple approach saved more than three hours in teacher and staff time per month.[67]

The pattern of professional development in American schools has long been focused on "one shot" workshops where instructors introduce teachers to a methodology or topic and lead them through exercises to familiarize them with the processes and content. Follow-up study, classroom observations, links to student activity, and measuring results have generally been absent. To be effective today, professional development must be based on a new mode of continuous improvement linked to the program goals of the institution and the performance of teachers and students in the classroom.[68]

To enrich learning and obtain the benefits of technology, activities with follow-up and mechanisms for comment in the classroom should be constructed and made available for all teachers. One-time sessions are not particularly effective. As educators begin to experiment with what they learn, new questions inevitably arise. Without some mechanism for addressing questions as they emerge, educators are reticent to try new approaches. Consequently, schools should increase the value of even minimal investments of time and resources for professional development by guaranteeing adequate follow-up.

It is important to differentiate professional development activities according to audience, content specialty, level, function, and contribution to the goals of the institution. All teachers, for instance, can learn to use e-mail to enlist home-school collaboration for their classroom activities, to keep parents informed of homework, and to conduct asynchronous conferences. History teachers can learn to enlist museums and experts through the Internet, while science teachers can learn to locate resource sites and online conversion calculators to aid students in project completion. Professional development with technology should focus on how to use computers, software, and other technology tools to teach, not on mechanics. Similarly, technical experts should not be the sole instructors in professional development programs. While they may be proficient with technology, they often have little understanding and experience using technology to meet core subject matter objectives or broader pedagogical concerns.

Ongoing support, including strong participation from principals, administrators, community leaders, and parents can enable all teachers to master new methods and operations, explore

new techniques and applications, and observe the effects on student performance. The technology itself can enable them to share best practices and mentor one another. To accomplish this, however, requires a move away from "one-shot" training. It also requires professional development with technology for those making decisions in schools and requires giving a voice in direction, planning, and implementation to teachers with technical expertise and hands-on experience using technology to teach.

It also requires making time for professional development with technology. Teachers in our nation's K-12 schools work an average of 45 hours per week with 33 of those hours spent at school. Of the remaining 12 hours, teachers spend slightly more than three on activities involving students and almost nine on other teaching-related activities.[49] It is no surprise, therefore, that more than 50 percent of schools still allow technology professional development to be optional.[50] Consequently, many dedicated educators sacrifice their personal time to learn about technology. While teachers should always share responsibility for their own professional development, primarily relying on teacher personal time will never enable a culture of effective technology use. Self-directed training should supplement, not substitute for, sanctioned, supported, and continuous professional development.

Meeting Individual Teacher Needs: The Teacher Technology Adoption Process

To be effective, professional development programs need to accommodate the program goals of the institution, the targeted results for students, the level of sophistication of teachers who participate, and the technology available. Since teachers are the linchpins of success for students, their individual requirements for mastering new methods, knowledge, and techniques deserve particular attention.

Experience suggests that teachers, even those most enthusiastic about teaching with technology, typically pass through several distinct stages before they become education technology integrators and innovators. Progression through stages of technology adoption and integration is not unique to the education community.[51] For decades, corporate America has witnessed a similar progression as businesses have increased the presence and use of technology, first for internal operations and then for interactions with vendors and customers. Corporate researchers also have identified a cycle of technology integration that progresses through planning, investigation, and experimentation stages to the emergence of new work and organization models.[52] Though not identical to the stages of teacher technology adoption described here, they are similar enough to suggest that technology integration, no matter where it occurs, is a process that evolves over time.

Evolution Not Revolution: Managing Change[53]

Assistant Principal Dwayne Young is working hard to ensure that Louise Archer Elementary School in Vienna, Virginia is a "safe" place for teachers to become education technology leaders. Louise Archer's education technology plan evolves as the teachers and students evolve, decreasing dependence on school administrators and the in-house computer expert as teacher and student knowledge, needs, and comfort increases. Young, a former teacher at the school, reports that until recently, even some of the teachers in this technology-rich school viewed technology as inevitable, as something they had to accept. Now, he says, teachers are beginning to see the possibilities for themselves. "Our goal is to create an environment that encourages teachers to explore, learn, and determine what's best for them and their students in any given circumstance. We want our teachers to know enough about using technology that they can take the lead in determining whether, when, and how to incorporate it as they work to improve the performance of our students and our school." For an inside look at Louise Archer, visit its student-created web site at www.fcps.k12.va.us/louisearcher

Tailoring professional development opportunities can help schools ensure that technology is not merely considered inevitable, but is a valuable tool for creativity, collaboration, and innovation.

Lessons from Corporate America

Over the past decade, successful corporations, non-profit organizations, and government agencies have learned that investing in professional development with technology is instrumental to improving operations, enhancing results and ensuring better service.

- American businesses now invest $60.7 billion per year on formal employee education ensuring that 54.5 million employees receive some level of training from their employers.[14]
- More than 70% of that training takes place in classrooms with live instructors and more than 33% of formal training courses focus on computers.[15]
- Spending on technical training is growing rapidly. From 1996-1997, spending per person increased 74% for information services staff training and 33% for business staff.[16]

The following list describes five stages of teacher technology adoption. The list underscores the idea that understanding and using technology well takes time. It also outlines very distinct stages that suggest the need for tailored activities for professional development.

Stage 1: Entry

Students Learning to Use Technology. At this stage, teachers are not themselves the technology users. If students are using technology, they are using it in ways determined by someone other than the teacher and without participation from the teacher. For example, they may have a designated computer lab time taught by a computer teacher. Alternatively, they may have classroom computers that are used for educational software games which students independently use during assigned computer time.

Stage 2: Adoption

Teachers Use Technology to Support Traditional Instruction. Teachers are beginning to use technology usually to enhance their own productivity, mandated either by the school (e.g., electronic report cards) or through their own initiative. Teachers at this stage use technology in a limited way, to do things they already would have done without the technology. They experience an advantage doing traditional tasks with a new tool and begin to see the power of the tool for other applications. For example, a teacher who uses word processing software to prepare a newsletter to parents discovers how much easier it is than using a typewriter. Therefore, the teacher begins to provide opportunities for students to use the computer as a "better typewriter" for completing stories, reports, or other exercises.

Stage 3: Adaptation

Technology Used to Enrich Curriculum. Teachers begin to use technology in ways that are connected to the curriculum, and in ways that are already familiar. Teachers are automating existing practices. For example, a teacher who has located web sites with reference material relevant to a particular lesson is using that material to present the subject matter to the class. Perhaps the teacher is having students use CD-ROM encyclopedias and the Internet as an extension of print resources. Teachers at the adaptation stage tend to direct student inquiry (e.g., pre-selecting web sites) rather than allowing student-directed learning experiences.

Stage 4: Appropriation

Technology is Integrated, Used for its Unique Capabilities. Teachers at the appropriation stage view technology as a relevant tool for teaching and learning and they design learning experiences and environments to take advantage of its capabilities to meet objectives

and desired outcomes. In the classrooms of teachers at this stage, technology begins to reveal its potential to produce improvements in learning, as students master higher-order thinking skills and more complex concepts and skills than they would have encountered without technology. Students will view technology as a tool to meet their objectives. For example, a student assigned a project on a local environmental issue would be empowered to use the Internet and other technology resources, such as e-mail, to direct a personal approach to the project. The teacher might also allow students to determine individual presentation tools, and arrange for a presentation to the appropriate community organization.

Stage 5: Invention

Discover new uses for technology. At this stage, teachers are redefining classroom environments and creating learning experiences that truly leverage the power of technology to involve students in tasks that require higher-order thinking skills as well as mastering basic concepts and skills. For example, a teacher might create a theme or project around which to center most of the activities of the class for a semester. During that time, the teacher and students would create a project or series of projects that weave learning and demonstration ability in each of the required subject areas. For example, a class project to create a web site for a local business might involve the opportunity for the students to learn about the business, learn about web site creation, hone organizational skills, master content, and apply basic skills. Such a project might look to an outside observer more like a business environment than a conventional classroom, though a wealth of learning would be taking place.

Tailoring professional development opportunities to teacher and student skills and levels of receptivity can help schools ensure that technology is not merely considered inevitable, but is recognized as a valuable tool for creativity, collaboration, and innovation in teaching and learning.

Improving Student Performance: "Target Tech" Professional Development

The goal of boosting technology professional development throughout a teacher's career is to reach established educational objectives such as enabling teachers to teach better, students to learn better and communities across the nation to improve their public schools. With a base level of technology and connections now in American schools, it is time to focus new attention, energy, and resources on ensuring that teachers are prepared to put technology to work.

Motorola Increases Professional Development Investment; Improves Results[57]

As competition and technological innovation transformed the electronics industry, Motorola decided in 1979 to increase its investment in employee training. The Motorola Training and Education Center was born.

Motorola required and entitled every employee to spend at least 40 hours per year training. By 1995, corporations were spending an average of one percent of payroll costs on training; Motorola was spending three percent. By 1996, Motorola was spending $200 million per year teaching 142,000 employees skills including foreign languages, computer programming, marketing strategies, and statistics. The results included a dramatic reduction in product defects and time to market and skyrocketing sales figures.

Importantly, Motorola was able to measure their cost savings. Three separate studies commissioned by the company showed that when skills were taught, reinforced, and measured in terms of later job performance, Motorola reaped a $30-$33 return on every one dollar invested. Motorola was the first U.S. electronics company to outperform its Japanese competitors and, in 1988, was the first large corporation to win the Malcolm Baldrige National Quality Award.

Technology: A Professional Development Tool for Technology Professionals

At Lucent Technologies, keeping a dispersed team of professionals current on the technologies they service is a formidable challenge. To meet the challenge, the company created the Call Center Institute (CCI), an online resource center and knowledge warehouse accessible at any time, from anywhere. The CCI is home to more than 800 megabytes of information on current call center technologies and applications in the form of case studies, white papers, research articles, training materials, presentations, demonstrations and performance support tools. Not only can Call Center Specialists access the vast array of information through CCI; they can access each other. Whether sharing ideas, experiences, or best practices, the CCI's informal chat rooms, synchronous interactive teleconferencing programs, web-based seminars, and "teleco!laboration consultations" with product engineers help this worldwide team stay current and connected. For more information about CCI, contact Alan Chute, Director, Lucent Technologies Center for Excellence in Distance Learning at 513-768-5248.

Putting Professional Development to Work in Schools

To help guide the nation's schools toward better technology-related professional development programs, the CEO Forum has updated its School Technology and Readiness Chart (STaR Chart) which was first released in October, 1997. This self-assessment tool is designed to help K-12 schools chart their readiness to use and integrate technology in teaching and learning. The STaR Chart identifies a continuum of school profiles, from the "Low Tech" school (with little or no technology in use) to the "Target Tech" school (the model for innovative use of education technology).

The CEO Forum STaR Chart is an evolving document that changes as technology changes and as school adoption, integration, and use of technology changes. It is not intended to be a measure of any particular school's technology and readiness, but rather a benchmark against which every school can assess its own progress. In the coming year, the CEO Forum will work with leaders at American schools of education to adapt the STaR Chart specifically for teacher colleges. The goal is to create a guide that meets their particular needs and unique role in the teacher education process.

In all efforts to apply the assessment tool created by the CEO Forum, it is important to recognize that each school and district is unique. Even in terms of professional development, each district has distinct needs and budget constraints, particular challenges to overcome and specific resources and advantages available.

Nevertheless, as the STaR Chart indicates, a Low Tech school with one computer in the administrative office and no connection to the Internet should have a technology professional development plan. So, too, should the Target Tech school with a cluster of computers and Internet connections in every classroom. While the plan for every school will be different and will evolve over time, the CEO Forum believes there is always room for improvement and an important action agenda to pursue.

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About the STaR Chart

A Tool for Assessing School Technology and Readiness

The STaR Chart can help any school or community answer some critical questions:

- **Is your school using technology effectively to ensure the best possible teaching and learning?**
- **What is your school's current education technology profile?**
- **What criteria should be used in judging your progress?**

First released in 1997, the STaR Chart was created by the CEO Forum to provide a clear framework for understanding how well schools are prepared to equip students with the knowledge and skills they need to thrive in today's information technology economy.

The STaR Chart is a tool that can help all schools create and implement a plan for improving education with the help of information technology. Over the past year, education leaders nationwide have used the STaR Chart as a road map to help understand and plan for the integration of education and technology. Here are some of the ways the STaR Chart has been put to use:

- **Setting benchmarks and goals** Schools, districts, and states have used the STaR Chart to identify current education technology profiles, establish goals, and measure their progress.
- **Applying for grants** The STaR Chart has helped schools and school districts identify their education technology profiles and objectives as they apply for technology-related grants.
- **Determining funding priorities** Education leaders have also used the STaR Chart to help determine where to allocate funds to fill gaps.
- **Creating assessment tools** Education policymakers have used the STaR Chart to help construct their own state technology assessments.

The new Year 2 STaR Chart provides an in-depth look at the professional development practices of schools ranging from "Low Tech" to "Target Tech."

No matter where a school falls along the spectrum, the STaR Chart offers valuable information that can inform discussions, drive decisions, and produce results.

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(STaR) Chart:

Star Indicators	Hardware				Connectivity		
	Students per computer	Students per multimedia computer	Students per CD-Rom	Maintenance	Lab	Classroom	Speed
LOW Tech	8-20 students per computer	More than 17 students per multimedia computer	More than 100 students per CD-Rom	Off-site irregular maintenance	No	Maybe	Dial-up access
MID Tech	5-11 students per computer	8-33 students per multimedia computer	More than 50 students per CD-Rom	Off-site irregular maintenance	Yes	Yes	Dial-up access
HIGH Tech	4-8 students per computer	5-13 students per multimedia computer	More than 17 students per CD-Rom	Off-site regular maintenance	Yes	Yes	Dial-up and Dedicated Line (e.g. ISDN, T1)
TARGET Tech	2-5 students per computer	3-6 students per multimedia computer	6-25 students per CD-Rom	On-site continual maintenance/ replacement	Yes	Yes	High Speed Dedicated Line (e.g. ISDN, T1, T3)

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A New Look at Professional Development

How to find your school's professional development profile

The CEO Forum's STaR Chart is a guide, not a definitive measure, of a school's effectiveness in integrating technology into the teaching and learning process. Your school may fall within one category based on certain indicators and in another based on other indicators. Such mixed readings are expected because every school is unique. The STaR Chart allows any school, district, or state, no matter what its budget, priorities, or current educational technology profile, to better understand where it is today and better plan for its future goals.

1. Select one of the three categories located across the top: Content of Training, Professional Development Practices, or Technology Access and Usage Patterns.
2. Under the selected category, find the box that best describes your school's efforts (it's possible that your school may fall between two boxes).
3. After finding where your school falls, compare your school's program components with the ones listed in the Target Tech box, which describes the ideal scenario.
4. Use your findings to start discussions with staff, administrators, technology directors, school board members, and community leaders about improving the professional development portion of your school's education technology plan.

Availability of Drill and Practice	Availability of Applications for Creation	Availability of Simulation Software	Availability of Research Resources	Availability of Networked Communication	Content of Training	Professional Development Practices	Technology Access and Usage Patterns
Yes	Maybe	Maybe	No	No	• How to use basic technology tools and applications (i.e. word processors, spreadsheets, productivity applications, LCD projectors)	• Training occurs in isolated, short, "stand-alone" sessions • Training delivered by non-teachers (technology and pedagogy are not linked or connected) • Most teachers not engaged in technology-related professional development • No long-term professional development plan in place	• Most teachers at "entry" and "adoption" phases (see definitions above) • Most teachers do not have access to appropriate technology in their work areas • A few teachers use technology to enhance personal productivity • Technology used as substitute for manual work; "fit" into existing work
Yes	Yes	Maybe	Maybe	Maybe	• How to use basic technology tools and applications • How to use stand-alone software • Limited introduction to the Internet	• Training occurs in isolated, short, "stand-alone" sessions • Some teachers engaged in technology-related professional development • No long-term professional development plan in place	• Some teachers at "entry" and "adoption" phases; a few teachers at "adaption" phase • Some teachers have access to appropriate technology in their work areas • Some teachers use technology regularly, as a substitute for manual tasks (i.e. word processors used to construct assignments) • A few teachers use technology sporadically as an add-on, supplementary educational tool (i.e. stand-alone software used as supplementary educational tool) • Internet use is limited and sporadic
Yes	Yes	Yes	Yes	Maybe	• How to integrate technology into the curriculum • How to use technology for classroom management • How to identify and use grade, age, and subject specific multi-media materials • (Training on basic technology tools and applications also available for small subset of new teachers)	• Training occurs in regular, consistent sessions integrated into regular school schedule • Teacher trainers provide coaching and model best practices ("train-the-trainer") • Most teachers participate in technology-related professional development • Most teachers participate in virtual or face-to-face peer discussion groups • Most teachers have access to in-school training as well as on-line, distance learning resources • Long-term professional development plan is in place	• Most teachers at "appropriation" phase; some teachers at "adaption" phase; a few teachers at "entry" and "adoption" phases • Most teachers have access to appropriate technology in their work areas • Most teachers use technology regularly for administration and in the curriculum • Most teachers select, use and integrate technology tools in constructing of student assignments • On-line resources used and integrated into curriculum
Yes	Yes	Yes	Yes	Yes	• Subject of training is customized to needs individual teacher • How to create new technology supported learning activities and lesson plans • How to identify, use and evaluate grade, age, and subject specific multi-media materials • How to meet special, individual needs using technology • How to identify, use and evaluate new student assessment methodologies	• Delivery of training is customized to needs of individual teacher • Training is one-on-one, just-in-time and on-demand • All teachers participate in on-going technology-related professional development • All teachers have access to in-school training as well as on-line, distance learning resources • All teachers engage in on-going self-assessment • Long term professional development plan is developed with teacher participation and institutionalized	• Most teachers at "appropriation" phase; a few teachers at "invention" phase • All teachers have access to appropriate technology in their work areas • All teachers select, use, and evaluate information technology tools as needed to create lesson plans and communicate and collaborate with students, peers, experts, parents and community • Daily work, teaching, and learning are not possible without technology • "Individualized," student-centered curriculum created and used in classroom • Technology is fully integrated into the curriculum and fundamentally changes process of teaching and learning

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The Stages of Professional Development

In defining professional development profiles, the Year 2 STaR Chart builds upon the five phases of professional development identified by Apple Classrooms of Tomorrow (ACOT) through a decade of research on the instructional changes that occur during the process of integrating technology to transform the learning environment:

Entry Educators struggle to learn the basics of using technology.

Adoption Educators move from the initial struggles to successful use of technology on a basic level (e.g., correlation of drill and practice software to classroom instruction).

Adaption Educators move from basic use to discovery of its potential for increased productivity (e.g., use of word processors for student writing).

Appropriation Having achieved complete mastery over the technology, educators use it "effortlessly" as a tool to accomplish a variety of instructional and management goals.

Invention Educators are prepared to develop entirely new learning environments that utilize technology as a flexible tool. Learning becomes more collaborative, interactive, and customized.

Integration And Use			Educational Benefits
Teacher-centered, teacher as lecturer of whole group	Irregular individual use	Short	• Master basic skills through older drill and tutorial software
Teacher directed, whole group learning	Regular individual use for some students	Short	• Improve higher-order critical thinking with access to multimedia content • Master basic skills through drill and tutorial software • Greater information resources available for research and education from Internet and CD-ROM but constricted due to lack of access
Teacher facilitated	Irregular group use for short collaborative activities; regular individual use for most students	Extended	• Improve higher-order thinking and research skills • Greater information resources available for research and education from Internet and CD-ROM • Most students/teachers able to communicate with parents, experts, other students and teachers outside the school
Teacher as guide, student-centered learning	Regular individual and group use of technology as tools when needed	Extended	• Student-centered authentic project-based learning • Improve higher-order thinking and research skills • Universal access to greater information resources available for research and education from Internet and CD-ROM • Collaborative learning that allows students to develop teamwork/communication/problem-solving skills • All students/teachers able to communicate with parents, experts, other students and teachers outside the school

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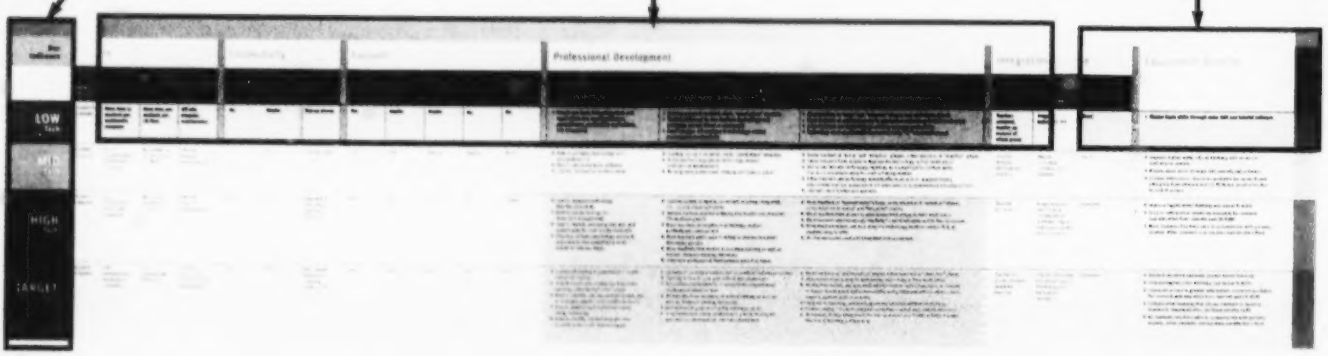
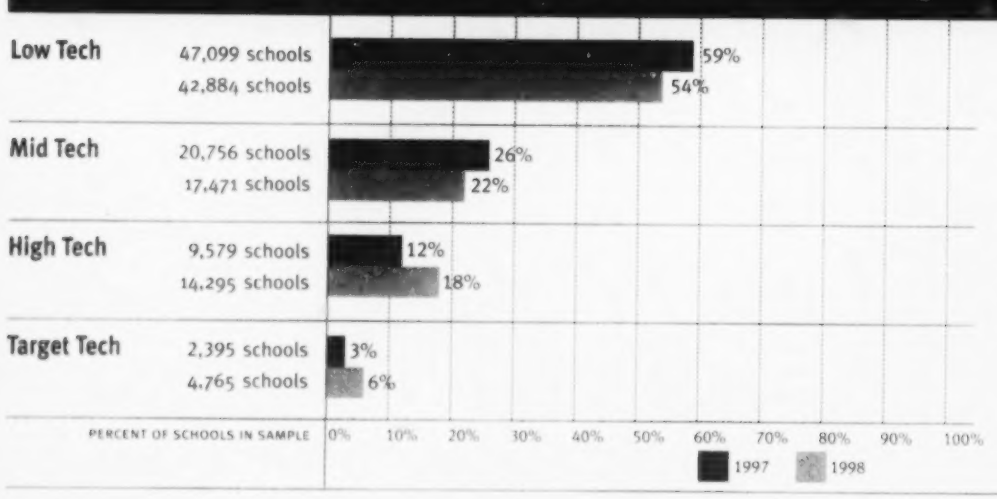
The CEO Forum's School Technology and Readiness Chart (STaR Chart) identifies and defines four school profiles ranging from the school with "Low Technology" to the "Target Technology" school that fully integrates technology throughout the curriculum.

Based on technology presence, use, and integration throughout the curriculum, the STaR Chart provides a likely technology snapshot of a school in each of the profile categories.

The STaR Chart also matches potential educational outcomes — the potential benefits — to the level of technology and integration in each profile category.



Year 2 National STaR Assessment



24% of schools effectively integrate technology while more than 50% remain in the Low Tech category.

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The CEO Forum on Education and Technology

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Founded in 1996, the CEO Forum on Education and Technology is a unique four-year partnership between business and education leaders who are committed to assessing and monitoring progress toward integrating technology in American schools. The CEO Forum hopes to ensure that the nation's students will achieve higher academic standards and will be equipped with the skills they need to be contributing citizens and productive workers in the 21st century.

Organizing Principles

- All students must graduate with technology skills needed in today's world and tomorrow's work place.
- All educators must be equipped to use technology as a tool to achieve high academic standards.
- All parents and community members must stay informed of key education technology decisions confronting policymakers, administrators, and educators.
- All students must have equitable access to education technology.
- The nation must invest in education technology research and development.

The CEO Forum Four Year Agenda

Year 1: In *The School Technology and Readiness Report: From Pillars to Progress* (October 1997), the CEO Forum issued the STaR Chart, a self-assessment tool individual schools can use to gauge their progress toward integrating technology to improve education. The CEO Forum issued the first STaR Assessment, a benchmark measure of national progress toward integrating technology in education.

Year 2: Focusing on the issue of professional development, the CEO Forum Year 2 *School Technology and Readiness Report* called *Professional Development: A Link to Better Learning* (February 1999), includes a status report on educator professional development, an update of the STaR Chart to include new criteria for assessing individual school progress on professional development, and an update of the STaR Assessment.

Year 3: The CEO Forum will update the content section of the STaR Chart, report on the nation's progress in developing and integrating digital content, and update the STaR Assessment.

Year 4: In its final year, the CEO Forum will address the important question of how to measure the impact of technology on student achievement and educational outcomes as well as update the STaR Chart and STaR Assessment.

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Principles for Successful Technology Professional Development

1 Set Relevant, Realistic Goals. Before creating and implementing a technology-related professional development plan, all stakeholders must have a clear vision of the objectives the plan will help meet. It is critical to remember that technology for technology's sake is not the key. The key is creating a plan that will enable teachers to use technology and the expansive resources it makes available to improve student performance and achievement.

The CEO Forum believes there are three cornerstones upon which to build effective plans for technology professional development. Professional development efforts must be:

- integral to the core mission of the institution;
- supported at the highest levels within the organization and the community; and
- endorsed and supported by teachers in the classroom.

On this foundation, the CEO Forum offers the following principles to help schools throughout the education system design and implement their own plans for effective technology professional development.

Principles

1. **Set Relevant Realistic Goals**
2. **Include All Stakeholders; Capitalize on All Resources**
3. **Link Professional Development to Teacher and Student Needs and Objectives**
4. **Model Best Practices**
5. **Encourage Learning by Doing**
6. **Provide Resources, Incentives, and Ongoing Support**

1 North Carolina: High Standards for a High Tech Age

North Carolina underscores its strong commitment to education technology in its standards for teachers. All new teachers are required to take a state-administered test composed of multiple choice questions on technology and an interactive activity where they must answer questions and manipulate data. In addition, new teachers are responsible for producing a portfolio demonstrating advanced technology skills. Portfolios are assessed by a committee of public school and university faculty members assembled by the new teacher's pre-service program. As of this year, current teachers applying for their five-year license renewal also must have amassed 30-50 hours of technology training. Each district is responsible for devising its own plan for meeting this requirement. To find out more about what North Carolina expects of its teachers see **www.ofps.dpi.state.nc.us**

1 Providing Standards-Based Professional Development Models

Through the Reinventing Education grant program, IBM is working with the San Jose Unified School District to develop an electronic tool for teacher professional development. The goal is to help teachers integrate technology into instruction. The tool guides and instructs teachers on activities to help them progress along a continuum from "emerging" user of technology to "exemplary." The tool also helps teachers collect the work from these activities, keep journals that can be shared online, and create personalized plans for growth.

The district also is implementing two new models of professional development. In one, teacher teams work with specially skilled classroom teachers, engaging in hands-on, classroom-based learning to build upon their teaching skills, especially in the effective uses of technology. Through the second, a teacher (or team of teachers) designs a standards-based project that focuses on an instructional concern that technology potentially could address. Projects are implemented in the classroom, along with any training or other support that might be required, and findings are evaluated and disseminated so that they may be helpful to other teachers. For more information, visit **www.ibm.com/IBM/IBMGives/k12ed/k-12init.htm**

2 Involve All Stakeholders; Capitalize On All Resources. Professional development activities must involve all stakeholders from school principals, administrators, and community leaders to teachers, parents, and students. A clear expectation for how technology can meet core objectives is critical and each stakeholder must lend experience and expertise in both the planning and implementation phases.

1 Setting Goals and Meeting Them

Diane Hathaway, Principal of Philadelphia's Hill-Freedman Middle School, knew that making her school "Target Tech" would require clear objectives and hard work. The school lacked both a computer cluster and a computer teacher. She would have to serve simultaneously as principal, computer teacher, and repair woman. Nevertheless, under Hathaway's guidance, "mini-clusters" of least six computers and two printers were located in every instructional classroom. All school personnel from teachers to custodians received training at the district training center. Over a period of a year and a half, every available in-service day was devoted to technology training. To ensure that teachers used their training, Hathaway decided to accept lesson plans only by e-mail, posted daily announcements exclusively on the Internet, and evaluated teachers on their use of technology. **www.phila.k12.pa.us/schools/hill_freedman/**

2 Involving Teachers in Planning

The technology committee for the Chittenden South Supervisory District in Hinesburg, Vermont plans and implements technology use in all district schools. The committee, composed of fifteen teachers and media specialists and an assistant superintendent, functions as both a de facto decision-making body and a forum for sharing information among the district's schools. In addition, the committee's meetings function as informal in-service time for the members, providing them with new knowledge and skills to bring back to their home schools. There, they serve on local technology committees and field suggestions and questions from their colleagues. To learn more about the committee visit **www.cssd.k12.vt.us/tech.htm**

2 Kids Can![18]

As Indiana's Butler University teacher preparation program began working to boost understanding and use of technology in education, Dr. Matthew Maurer wanted to be sure to tap into all available resources. To that end, he designed a "Junior Professor" program to dispel pre-service teachers' notion that technology is too sophisticated for young students. Butler pairs "Junior Professors," ranging in age from first to fifth grade, with small groups of pre-service teachers. The Junior Professors teach the groups graphics and hypermedia programs. Inevitably, the children's abilities surprise the student teachers. They learn that they must not be afraid to challenge children to use technology. The Junior Professors feel a sense of accomplishment and empowerment.

2 Professional Development and The Teacher's Toolbox

As part of the district's 40-hour technology training program, teachers in Washington State's Kent School District are taught to use the district's Teacher's Toolbox web site. Among other things, the web site allows teachers to complete otherwise cumbersome paperwork online, find information on their students, share lesson plans, and sign up for professional development activities. The web site gives teachers who might not otherwise use technology a reason to do so. By using the Toolbox, teachers become more comfortable with using technology. This is a first step in preparing teachers to integrate technology into the classroom. An added bonus is that the Toolbox saves teachers' time. The district calculated that simply allowing elementary school teachers to order student lunch online saves each teacher 30 minutes, and the district $130,000, weekly. Check out Teacher's Toolbox at **www.kent.wednet.edu**

3 Link Professional Development to Teacher and Student Needs and Objectives. Education technology efforts should link to the core lessons a teacher is teaching and to the skills the student is working to acquire. Similarly, skills taught and experience leveraged should be relevant to the learner's life. For the future teacher, that means learning to teach with technology. For the student soon to join the workforce, it means learning technology skills and the use of technology to solve problems and achieve objectives.

4 Model Best Practices. Using technology to teach about effectively using technology demonstrates the power of the medium to meet pre-determined objectives. By modeling and setting examples for use, technology best practices become self-evident.

3 A Model of Excellence: Iowa's Graceland College[39]

It may seem odd at first that Graceland College's School of Education — a school with no education technology course — is a model of excellence. But it is. To foster a more integrated approach to education technology, Graceland eliminated its stand-alone education technology course in 1996. Now, the Educational Technology Coordinator works with other professors to develop education technology modules specific to each course ensuring that students learn how to use technology in the context of different disciplines. Faculty members at Graceland continually improve their education technology skills by consulting with the Coordinator, attending one another's classes during education technology modules, and by participating in supplementary workshops. For more information on Graceland's School of Education see **www.graceland.edu**

3 Taking Risks, Getting Rewards

Marna Weiss, music teacher and band director at Lakeland High School in New York state, was asked to coach a student team entering a college scholarship contest sponsored by ThinkQuest. The challenge: develop a web site to help others learn. Knowing little about the web, Miss Weiss suggested that a computer teacher should help. The students knew the technology, but needed Miss Weiss because she knew about music. Miss Weiss reluctantly agreed. Two years (and two winning ThinkQuest entries later) other teachers now come to Miss Weiss for advice on using computers, software, and integrating the web in their classrooms. "At first I just wanted to give the team feedback," says Miss Weiss. "Then the kids' excitement and motivation got to me — they were doing extraordinary academic work and loving it." Miss Weiss was hooked. "I discovered a whole new way to research, learn, and use technology," she says. "The kids taught me so much and as they did, they grew intellectually and socially. This has truly been one of the most rewarding and authentic professional development experiences of my career." For more information about ThinkQuest, visit **www.thinkquest.org**

4 Integrating Technology: A First-Hand Look

Each prospective teacher at George Mason University in Fairfax, Virginia sees the power of technology in teaching first-hand when taking a required course that introduces technology use in education. Using databases, office and other software packages, students develop lesson plans, create multi-media presentations, and evaluate the pedagogical utility of different software packages. George Mason is also launching a program to teach future junior high and high school teachers how to use technology by pairing methods professors — those who teach a particular subject — with technology specialists. At the elementary level, GMU includes a discussion about effective uses of technology for each skill taught. For instance, if the lesson is pedagogical uses of role playing, prospective elementary school teachers will discuss when technology use is appropriate. For more information contact Deborah Sprague at **dspragu1@gmu.edu**

4 Spotlight on Peabody College at Vanderbilt University in Tennessee[40]

At Peabody College, aspiring teachers are immersed in technology as the faculty models technology-enabled teaching throughout the curriculum. Students routinely use multi-media materials and digital resources in their coursework. For example, students may control video clips of a teacher working with special needs students and then respond interactively to questions. To create such a high-tech environment, Peabody invested in its faculty members by offering them a reduced teaching load for a semester so they could spend time revamping their courses. To learn more about Peabody go to **www.peabody.vanderbilt.edu**

5 Encourage Learning by Doing. Few techniques are more effective than learning by doing. By creating an environment that empowers teachers and students to learn to use technology through practical experience, institutions can begin to see benefits quickly. Teachers should use technologies such as distance learning, online networking, and web- and computer-based classes to access professional development resources. They should also use technology to communicate and exchange ideas with peers locally and around the globe. Similarly, students should be encouraged to learn by doing and to share new knowledge with peers.

4 Faculty First at Iowa State[41]

Iowa State University made a conscious decision to integrate technology tools into its educational curriculum. Before teaching students however, faculty had to come first. In 1992, Iowa State established a mentoring program for undergraduate and graduate students to mentor faculty members about technology. Ann Thompson, Director, Center for Technology in Learning and Teaching at Iowa State University, says that the program allowed faculty members to weave technology into projects of interest in a non-threatening way. Based on Iowa State survey data about faculty attitudes toward technology, faculty member self-confidence with technology has grown since the program began. Iowa State also offers a minor in educational computing through its school of education. Enrollment is now at 150 students, a 100 percent increase in two years. Iowa State works with the University of Virginia and University of Exeter in England in the Coalition for Innovation in Technology and Teacher Education (CITTE). CITTE defines visions for appropriate technology use in the classroom and produces videos and demonstrations on the effective classroom use of technology. For more information, contact Ann Thompson, **eat@iastate.edu**

4 Pyramid to Success

Imagine a school where 100 percent of teachers are voluntarily active in technology training. Does it seem improbable? It did to Dr. Carol Utay of Jessamine County until she began the "Tag Team" program at Warner Elementary School. The Tag Team works according to a simple pyramid scheme. Initially, a small group of teachers was offered training on the condition that they use their training to create a technology-infused project with a teacher who had not yet been "tagged" for training. As new teachers were "tagged" they similarly agreed to involve another teacher in a technology-infused collaborative project. The snowball effect was impressive. Through the Tag Team program, all teachers at Warner Elementary are involved in technology training. Teachers know that when they join the tag team they will be involved in authentic projects and that their self-selected buddy — presumably someone they like working with — will support them through the process. To learn more about Jessamine County's Technology Programs visit **www.jessamine.k12.ky.us/dop/technology.html**

5 Girls Teaching Girls: Ensuring Equity and Leveraging Experience[42]

Palos Consolidated School District 118 in Palos Park, Illinois is working to ensure that the girls in its schools have an incentive to explore and learn with technology and that new expertise is passed to other girls.

Through a program called Girls and Technology: Skills, Computers, Awareness, and Peer Empowerment (GATSCAPE), sixth, seventh, and eighth-grade girls at all levels of computer literacy and ability receive unrestricted access to technology both during classes and after school.

The program goal is to leverage technology learning to nurture and enhance leadership abilities and problem-solving skills. Through role-playing, real-life situational activities, and games, girls become confident risk-takers willing to collaborate and support one another. The girls are encouraged to convey new skills to other girls formally and informally.

The GATSCAPE program was honored at a 1996 summit meeting of the Pioneering Partners Foundation (www.pioneeringpartners.org), a nonprofit that seeks to spread technology use in education by investing in people. The team used the $5,000 grant to expand and enhance the program to touch more students. For more information, contact Margaret Johnson, District Technology Coordinator, **mjohnson@d118.s-cook.k12.il.us**

5 Real Schools, Real Solutions: Professional Development Internship-Style

Carteret County's "Learning Environments for the Next Century" (LENC) Project gives current teachers the opportunity to "intern" with a mentor teacher for two days in an actual classroom. Master teachers are selected to serve as technology mentors. The mentors are responsible for developing technology-infused classroom projects or "Units of Practice." Over the course of the year, pairs or groups of other teachers will join the mentors and their students for two days to participate in a Unit of Practice. After the internship, participants generate an action plan and timeline for creating their own collaborative, interdisciplinary Unit of Practice. Mentors support participants through a series of follow-up sessions. Conducting professional development directly in the classroom makes it more meaningful and realistic for participants. Moreover, unlike traditional professional development, the training exercise itself benefits students. Through LENC, mentors' students participate in exciting new projects with not one, but several, enthusiastic teachers. To learn more about the LENC project visit **www.marine.unc.edu**

6 Provide Resources, Incentives, and On-Going Support. A collective willingness to create the time and devote the resources to technology professional development is essential. The school community needs mechanisms to enable teachers to focus on professional development activities without jeopardizing their students and without primarily relying on teacher personal time. In addition, schools and districts should accept the risk of trying new ideas and testing creative approaches to help create an environment in which teachers are encouraged to experiment and students are inspired to learn.

5 Moving from Under-Performing to Over-Achieving

When District 15 in Palatine/Rolling Meadows, Illinois decided to transform a disappointing traditional school into a technology rich, high performing school it started with the teachers. All teachers were given the choice of remaining at Willow Bend, the target school, to create a model school or transferring to another school in the district. Ninety-nine percent of teachers decided to stay. Between the spring and fall of 1995, Willow Bend's education program was completely overhauled and virtually every available technology was infused into the school. The student to computer ratio improved to a ratio of 2:1. Expert teachers trained by the district primarily led the training sessions for their peers. A critical element of the successful transformation was changing the school schedule to allow teachers daily planning time and weekly group planning time. As a result of its innovative efforts, Willow Bend has jumped from one of the district's lowest performing schools to one of its highest performing schools despite high student turnover and a large language minority population.

6 A Win-Win Deal

The new contract between Brunswick City Schools and the Ohio Education Association Union is a win-win deal when it comes to professional development. Under the contract, teachers are paid at the substitute rate to attend professional development workshops during non-school days. The district wins because it pays what it would have paid had a substitute taught while the regular teacher was receiving training. Teachers win because they are paid for their professional development work. In addition and most importantly, students win. They benefit from their teachers' training without being deprived of their regular teacher as they would if the teacher had been pulled from the classroom. In addition, the district sets aside five days during the summer for professional development activities it feels are particularly worthwhile. Teachers who choose to attend these sessions are paid the per diem beginning teacher rate. Not surprisingly, nearly all eligible teachers attend. For more information, contact Connie Eskesen at **connieeiOO@aol.com**

6 Resources Mean Results for Houston Students

Over the past several years, the Texas Legislature has appropriated more than $25 million to establish field-based and technology-intensive programs in the state. Through the program, the state makes grants to teacher education programs at schools including the University of Houston, Texas Southern University, the University of St. Thomas, and Houston Baptist University. The purpose of the grants is to encourage teacher education institutions to develop their own technology capabilities as well as those of area elementary and secondary schools, and to support methodology courses on-site at the schools. The result is faculty and students working together in technology-enriched school environments.

Preliminary data show that this influx of resources is producing results. Students in these technology-enriched schools have increased their achievement on statewide tests in mathematics, reading, and writing. In addition, 43 percent of the teachers involved report that they have changed their teaching practices because of the program. To learn more, visit **www.ncate.org/projects/tech**

Section II

Year 2 STaR Assessment

Background

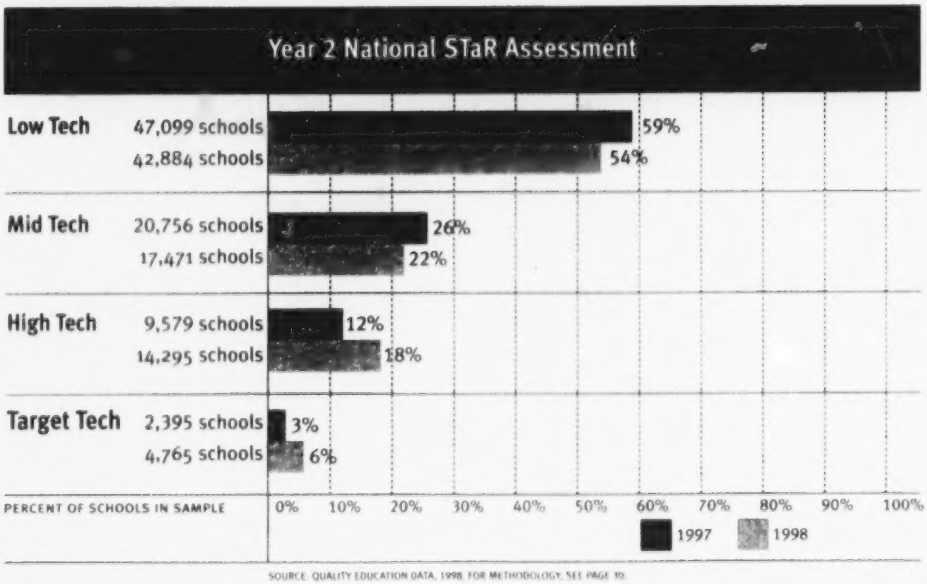
In 1997, the CEO Forum established a baseline measure against which to track the progress of American schools in integrating technology and technology use in classrooms nationwide. This school technology and readiness assessment, called the STaR Assessment, offered a snapshot of where the nation stood in its effort to integrate technology in education to improve academic standards and student achievement.

Following up on its commitment to issue an annual update of the STaR Assessment, this section of this report summarizes the Year 2 STaR Assessment of the CEO Forum. Again this year, the STaR Assessment is primarily based on hardware and connectivity data collected as part of a survey of the nation's public schools.[1] The STaR Assessment uses the CEO Forum STaR Chart as a backdrop to illustrate how our schools are doing.

Year 2 Summary

Overall, the assessment shows that schools are making gains. In fact, schools gained in all four STaR categories. The number of schools effectively integrating technology increased from 15 percent to 24 percent while the percentage of schools in the Low to Mid Tech range decreased from 85 percent of schools to 76 percent of schools. Specifically, the percentage of Target Tech schools doubled from three to six percent while the percentage of High Tech schools increased by half. Simultaneously, the percentage of Low Tech schools decreased by five percentage points. Despite such encouraging progress, more than 75 percent of America's schools remain in the Mid Tech and Low Tech categories.

These trends, and the information on the following pages, indicate that more students have greater access to better technology than they did last year. More students have access to multimedia computers and the instructional rooms at more schools have connections to the Internet. Although schools continue to make progress in building hardware infrastructures, commitment to teacher professional development with technology lags behind. As schools continue to put more connected computers into classrooms, the CEO Forum hopes that educators and policymakers will follow the recommendations in this report. To make the most of our national investment in education technology, we must ensure that teachers are well prepared to guide today's students to future success.



SOURCE: QUALITY EDUCATION DATA, 1998. FOR METHODOLOGY, SEE PAGE 30.

Year 2 Summary Profiles

The following section profiles typical schools in each of the four STaR categories. Not every school in a particular category will directly match these profiles, but they will share similar characteristics. The highlighted data points come directly from the Year 2 STaR Assessment.

Year 2 Low Technology School

Limited access to modern computer. Student-to-computer ratio of 10:1. Student-to-multimedia capable computer ratio of 25:1.

Older technology. Only 33% of all computers have processors equal to or greater than an Intel 386.

Might have Internet access. 39% of these schools have Internet access.

Limited number of networked computers. 71% of these schools do not have access to LANs.

Year 2 High Technology School

Significant access to modern computers. Student-to-computer ratio of 5:1. Student-to-multimedia capable computer ratio of 7:1.

Mostly new technology. 73% of all computers have processors equal to or greater than an Intel 386.

Prevalent Internet Access. 90% of these schools have Internet access.

More networked computers. 85% of these schools have access to LANs.

Year 2 Mid Technology School

Moderate Access to modern computers. Student-to-computer ratio of 7:1. Student-to-multimedia capable computer ratio of 12:1.

Older technology. 57% of all computers have processors equal to or greater than an Intel 386.

Might have Internet access. 73% of these schools have Internet access.

More networked computers. 70% of these schools have access to LANs.

Year 2 Target Technology School

Ubiquitous access to modern computers. Student-to-computer ratio of 3:1. Student-to-multimedia capable computer ratio of 3:1.

New technology. 81% of all computers have processors equal to or greater than an Intel 386.

Ubiquitous Internet access. 95% of these schools have Internet access.

Prevalent networked computers. 89% of these schools have access to one or more LANs.

Year 2 Data Snapshots

Hardware

In 1996, President Clinton articulated four pillars of education technology as part of his Technology Literacy Challenge: 1) hardware; 2) connectivity; 3) digital content; and 4) professional development.

These four pillars provide a foundation for creating an innovative learning environment that can prepare students for life and work in the digital world.

The CEO Forum believes the key to creating the best possible learning environment is the seamless integration of all four pillars in the nation's schools. This section presents a snapshot of current statistics in each of the four pillars.

Though educators require professional development and content resources, they must also be equipped with the tools to enhance learning in the next millennium. Providing hardware is a threshold condition upon which to build new ways of teaching and learning.

CONTINUED PROGRESS TOWARD INSTALLING COMPUTERS IN SCHOOLS

- In 1997–1998, schools provided one computer for every 7.8 students, an increase of 13 percent from 1996–1997.[64]
- More importantly, in 1997–1998, schools provided one multi-media computer to every 12.3 students. This is an improvement of 24 percent from the previous year.[65]

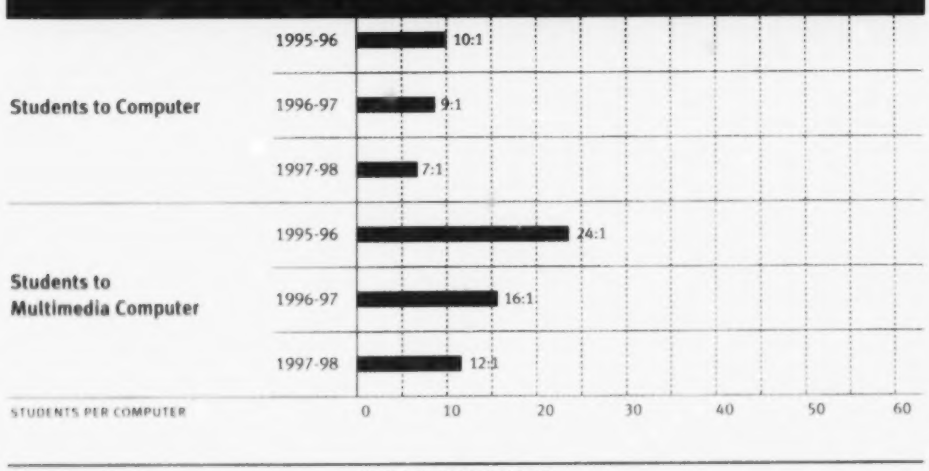
SCHOOLS PUTTING FUNDS TOWARD MODERNIZATION AND SUPPORT

- Schools continued to modernize their computer base. Of the 2.6 million computers purchased by schools last year, 40 percent replaced old computers laying the groundwork for the construction of a modern information infrastructure.[66]

SCHOOL INFRASTRUCTURES REQUIRE ATTENTION

- In 1995, approximately 42 percent of all schools and 52 percent of urban schools reported that they had insufficient electrical wiring infrastructure to support computer technology.[67]

Trends in the Number of Students Per Computer[68]



SOURCE: QUALITY EDUCATION DATA, 1998

Connectivity

Computers allow students to access educational content and create their own content. However, it is the combination of computers and networks that holds the most educational promise by enabling unprecedented communication and collaboration.

CONTINUED GROWTH OF SCHOOL ACCESS TO INTERNET CONNECTIONS, SCHOOL NETWORKS, AND CLASSROOM INTERNET ACCESS

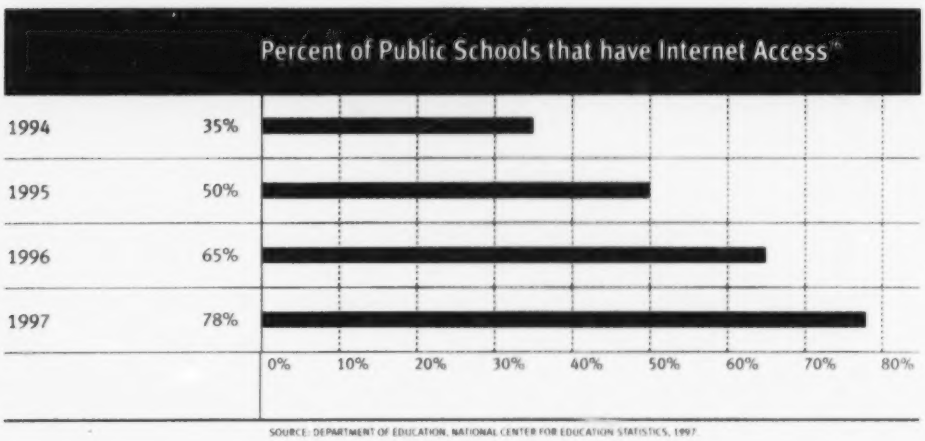
- In three years, the percentage of U.S. public schools with Internet access increased from 35 percent in fall 1994 to 78 percent in fall 1997.[69]
- The number of schools with five or more instructional rooms with Internet access increased from 25 percent of all schools in fall of 1996 to 43 percent of all schools in fall of 1997.[70]
- Fifty-six percent of schools reported have one or more Local Area Networks (LANs) installed in their building.[71]
- Schools spent an average of $30.68 per student on Instructional networks in 1997-1998.[72]
- In 1997, 55 percent of teachers indicated that they accessed the Internet from the library media center while only 31 percent indicated that they accessed the Internet from their classroom. This year, those numbers have reversed: 58 percent of teachers indicate that they access the Internet from their classroom, and 31 percent indicated that they access the Internet from a library media center.[73]

E-RATE DELIVERING FUNDING FOR TELECOMMUNICATIONS SERVICES, INTERNET ACCESS AND INTERNAL CONNECTIONS

- Through February 1, 1999, the Schools and Libraries Division of the Universal Service Administrative Company awarded more than $760 million to help schools increase connectivity.[74]

COMMUNICATIONS INFRASTRUCTURES BEING RE-WIRED

- Many elementary schools under construction will have no telephones in the classroom, a situation that could create problems in delivering technology. However, the majority of new schools under construction (more than 70 percent) are installing alternative delivery methods, such as fiber optics or cable.[75]



SOURCE: DEPARTMENT OF EDUCATION, NATIONAL CENTER FOR EDUCATION STATISTICS, 1997

Content

The power of technology is that it not only puts new, vast reservoirs of information at students' fingertips, but it allows them to create and disseminate their own information. Assessing the degree to which schools have integrated digital information into classrooms can be accomplished only by examining the availability and use of digital content and digital learning tools.

SCHOOL SPENDING FOR DIGITAL CONTENT AND RESOURCES RISING

- Schools spent an average of $5.42 per student on Instructional Internet services in 1997-1998, and plan to spend about the same in 1998-1999.[77]
- In 1997-1998, schools spent $6.51 per student on instructional software. They expect to spend $10.96 per student in 1998-1999, which is an increase of 68 percent.[78]

STUDENT INTERNET USAGE INCREASING

- In 1998, the number of students spending between one and five hours per week on the Internet increased by nearly one-third from 1997. The number of students spending six hours or more per week on the Internet more than doubled since 1997.[79]

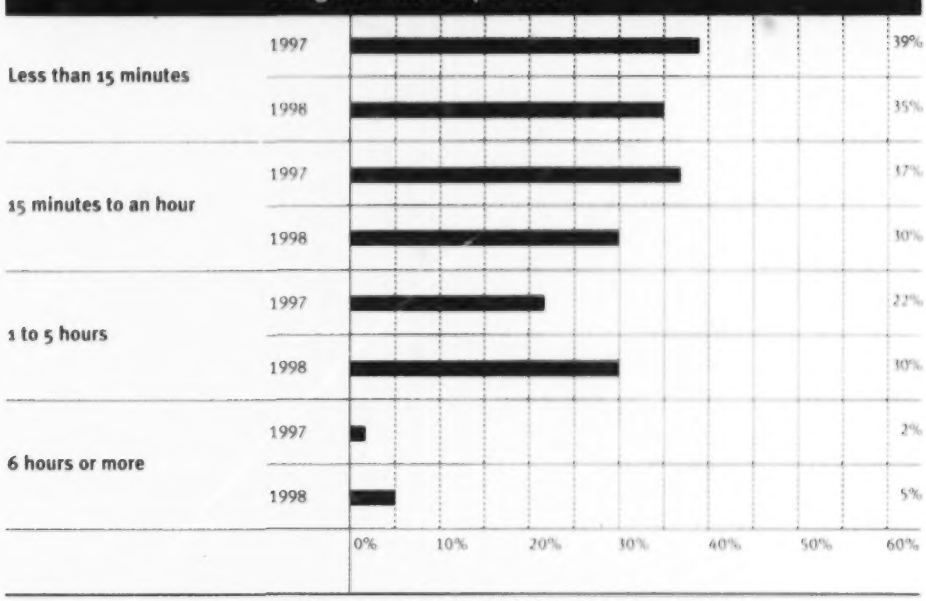
TEACHER COMPUTER USE

- At 23.1 percent of schools, teachers use computers daily.[80]

SCHOOLS GETTING ON THE WEB

- Approximately two out of every five schools have a homepage on the World Wide Web.[81]

Hands-On Time Spent by Students Using the Internet per Week[82]



SOURCE: QUALITY EDUCATION DATA, INTERNET USAGE IN THE PUBLIC SCHOOLS 1998.

Professional Development

Well-trained teachers are the keys to successful classroom technology integration. To ensure return on still rising investments in technology, schools must make a commitment to professional development by providing the required support, resources, and time for teachers to learn how to use technology.

PROFESSIONAL DEVELOPMENT INVESTMENT CONTINUES TO LAG BEHIND INFRASTRUCTURE INVESTMENT

- Schools expect to spend $5.65 per student on computer training of teachers in 1998–1999. This is five percent of overall school technology budgets. Schools spent $5.23 per student in 1997–1998 which was also five percent of the overall technology budget. In 1996–1997 schools spent $4.18 per student on computer training which again was approximately five percent of the overall technology budget.[83]

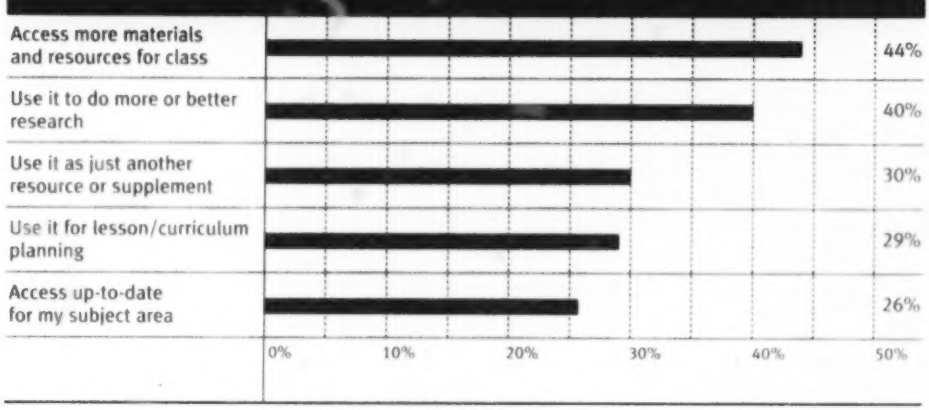
TECHNOLOGY FREQUENTLY INCLUDED AS PART OF TEACHER DEVELOPMENT PLAN

- Seventy-four percent of all schools address technology skills in individual teacher development plans. Eighty-one percent of Target Tech schools address technology skills in individual teacher staff development plans compared to 69 percent of Low Tech Schools.[84]

TEACHERS USING THE INTERNET MORE

- When asked whether they use the Internet in their teaching, 65 percent of teachers answered yes, an increase of 17 percentage points over 1997. Nearly 30 percent of teachers use the Internet daily and 80 percent use the Internet at least once a week.[85]
- Forty-four percent of teachers said that they used the Internet to access more materials and resources for class. Forty percent said that they used it to do more or better research and twenty-nine percent said they use it for lesson/curriculum planning.[86]
- In a 1997 survey, however, 80.5% of teachers surveyed cited "insufficient teacher training" as an obstacle to Internet use.[87]

How Internet Content is Integrated into the Curriculum[88]



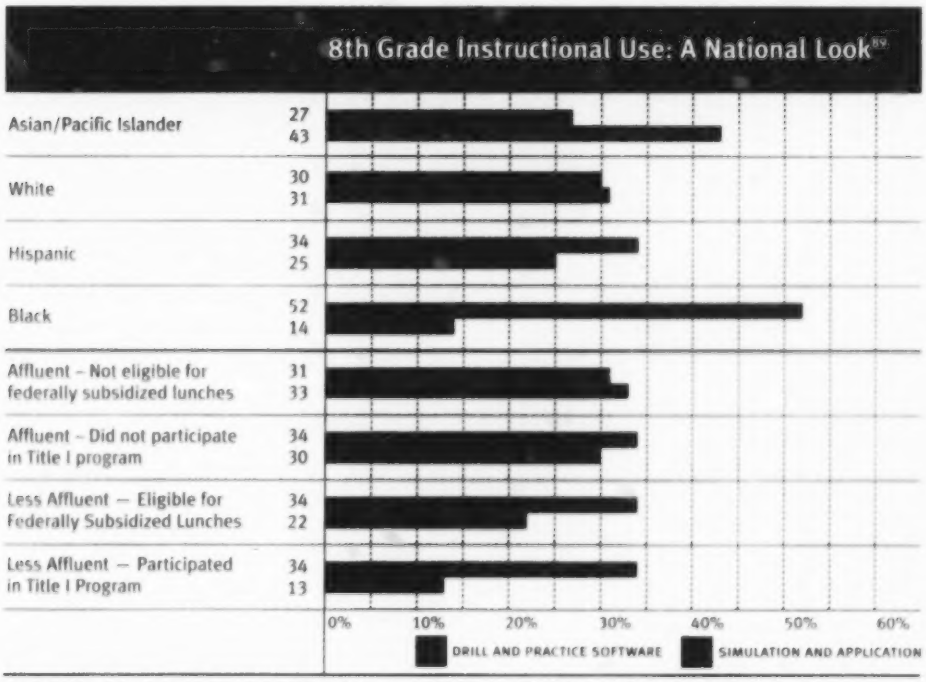
SOURCE: MARKET DATA RETRIEVAL SURVEY, 1997

A Call for Equity

One of the greatest promises of education technology is the potential for widespread, equal access to ideas and information. Through a networked computer, students can get up to the minute resources in the classroom. They can also access information online that may otherwise be unaffordable. Students in poor urban districts can take a virtual fieldtrip to see parts of the world otherwise beyond their reach. Education technology can also empower all members of a school community to communicate and collaborate with broader circles of peers and experts from around the corner, the country, and the globe.

However, just as the presence of technology has the potential to equalize opportunities for students from different backgrounds and different regions, the absence of these resources has the potential to widen the gap and build new barriers.

Although schools are logging onto the Internet at breakneck paces, schools serving poor or non-white students are less likely to have networks and connections to the Internet than those serving affluent or white students. In 1997, 88 percent of schools where less than 11 percent of students were eligible for free or reduced price lunch had access to the Internet.



SOURCE: EDUCATIONAL TESTING SERVICES, DOES IT COMPUTE?, AND UNPUBLISHED TABULATION FROM 1996 NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS.

It is imperative that technology be used to remove existing barriers and prevent the creation of new barriers.

That compares to 63 percent of schools where 71 percent or more were eligible for free or reduced price lunches — a difference of 25 percentage points.[9] Also, 84 percent of schools where minority enrollment is less than six percent had access to the Internet compared to 63 percent of schools where minority enrollment is greater than 50 percent — a difference of 21 percentage points.[10]

Though schools in all categories are lowering their student to computer ratios, schools in rich districts are doing it faster. In the 1997-1998 school year, schools serving the least affluent students (those in which 81-99 percent of the student body is eligible for free or reduced price lunches) lowered their student to computer ratio by 18 percent. Schools serving the most affluent students (those in which less than one percent of the student body is eligible for free or reduced price lunch) lowered their student to computer ratio by 24 percent.[11]

Other indicators are equally alarming. Even when access to hardware exists, students may have unequal learning experiences. One recent study found that at the eighth grade level, 31 percent of white students used computers mostly for simulations and applications, compared with just 14 percent of black students. At the same time, more than half of America's black students had teachers who used computers mostly for drill and practice compared with only 30 percent of white students. The study also showed that the students who used technology for simulations and applications received better test scores than those who used the technology only for drill and practice.[12]

In addition to inequities in school, there continue to be inequities in homes. As technology minimizes the boundaries of school walls by fostering communication and collaboration with parents and others, disparity in home computer ownership could increasingly impact student education. According to a recent Department of Commerce study, the percent of non-Hispanic white households that own a computer is double that of Hispanic households and African-American households.[13]

Policymakers recognize the need for equal access to technology. The E-Rate, a subsidy of telecommunications services and equipment for schools and libraries, provides greater discounts to poor and rural schools. Also, school districts may use Title I funds to purchase technology. However, ensuring equity in the *use* of computers is equally critical. As this report demonstrates, that includes professional development with technology for teachers. As the nation moves forward in integrating technology into the classroom, it is imperative that technology be used to remove existing barriers and avoid creating new ones.

Year 2 Methodology

QED Tech Measure Variables

1. The number of instructional computers per 100 students enrolled
2. The number of CD-ROM players per 100 students enrolled
3. The percent of all instructional computers that were either Macintosh or PCs having an 80386 or more recent processor
4. The number of computers per 100 students attached to local-area networks
5. Whether the school has one or more local-area-networks
6. Whether the school has a subscription to an online service or has Internet access in labs or classrooms
7. Whether the school has a direct Internet connection
8. The number of scanner devices per 100 students
9. The number of VCR units per 100 students enrolled
10. The percent of all instructional computers that are either Pentiums or Power Macintoshes
11. The number of multimedia computers (QED-defined) per 100 students
12. Whether the school has a dial-up Internet connection
13. The number of digital cameras per 100 students enrolled
14. The number of administrative computers per 100 students enrolled
15. The number of projection devices per 100 students enrolled

STaR Assessment

The CEO Forum's 1998 STaR Assessment is derived from Quality Education Data's (QED) Technology Measure,™ which was created by Dr. Henry Becker, Professor of Education at the University of California, Irvine. Drawing approximately 80,000 schools from QED's National Education Database™ of more than 87,000 public schools, the QED Technology Measure uses 15 variables to create a single index that measures the hardware and connections present in schools. These variables are listed to the left.

Each school is assigned a "raw" value ranging from one to seven, where seven indicates the most technology and connections present. When the data listed was improbable, not current, or incomplete, 8,273 schools were excluded.

To simplify the categories, the CEO Forum combined the QED Technology Measure categories with similar attributes into single categories. Categories one and two comprise "Low Tech" schools, category three represents "Mid Tech" schools, categories four and five comprise "High Tech" schools and categories six and seven comprise "Target Tech" schools.

The QED National Education Database is annually updated by data collected through mail, telephone, and online surveys. However, the difficulty of obtaining current technology data on each school means that some data is older than others. More than one-half of the 80,000 schools were updated in the last twelve months. For outdated schools, data is adjusted for likely technology improvements. For more information, see http://survey.qeddata.com

Star Chart

The six columns of the CEO Forum STaR Chart — Hardware, Connectivity, Content, Professional Development, Integration and Use, and Educational Benefits — were created using a variety of sources. The Hardware and Connectivity sections were created using information from QED s National Education Database™. The Content section was compiled from interviews and from logical assumptions about the activities that different technology infrastructures allow. The Professional Development section was compiled from interviews conducted by McKinsey and Company and supplemented by academic research. The Integration and Use section was compiled from interviews and academic research. Finally, the Educational Benefits section is derived from McKinsey and Company. For more information, see the CEO Forum STaR Chart itself.

Endnotes

1 For a list of links to studies on the impact of technology in education, visit www.ncrel.org/resources/technology/impact.asp

2 Wenglinsky, Harold. Educational Testing Service, Does it Compute? September 1998.

3 Quality Education Data. Technology In Public Schools, 16th Edition, 1998.

4 Market Data Retrieval. Technology in Education, 1998.

5 U.S. Department of Education, National Center for Education Statistics. Internet Access in Public Schools, March 1998.

6 Ibid.

7 Quality Education Data. Technology Purchasing Forecast, 1998-1999.

8 Wenglinsky, Harold. Educational Testing Service, Does it Compute? September 1998.

9 International Society for Technology in Education (ISTE) NETS Project, National Educational Technology Standards for Students, June 1998.

10 U.S. Department of Commerce. Falling Through the Net II: New Data on the Digital Divide, 1998.

11 U.S. Census Bureau. Statistical Abstract of the United States, 1998.

12 Progressive Policy Institute. The New Economy Index: Understanding America's Economic Transformation, November 1998. Internet host is defined as "a computer that acts as a source of information that can be obtained over the Internet."

13 Ibid.

14 Executive Office the President, President's Information Technology Advisory Committee. Interim Report to the President, August, 1998.

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16 Ibid.

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22 U.S. Department of Commerce. The Emerging Digital Economy, April 1998.

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24 Secretary's Commission on Achieving Necessary Skills (SCANS). What Work Requires of Schools, Department of Labor, 1991.

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31 Milken Exchange on Education Technology and International Society for Technology in Education. Information Technology in Teacher Education, February 10, 1999.

32 Ibid.

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Founded in 1996, the CEO Forum on Education and Technology is a unique four-year partnership between business and education leaders who are committed to assessing and monitoring progress toward integrating technology in American schools. The CEO Forum hopes to ensure that the nation's students will achieve higher academic standards and will be equipped with the skills they need to be contributing citizens and productive workers in the 21st century.

Organizing Principles

- All students must graduate with technology skills needed in today's world and tomorrow's work place.
- All educators must be equipped to use technology as a tool to achieve high academic standards.
- All parents and community members must stay informed of key education technology decisions confronting policymakers, administrators, and educators.
- All students must have equitable access to education technology.
- The nation must invest in education technology research and development.

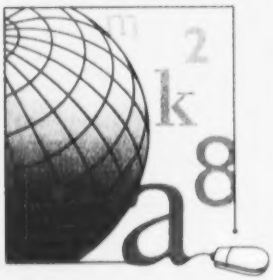
The CEO Forum Four Year Agenda

Year 1: In *The School Technology and Readiness Report: From Pillars to Progress* (October 1997), the CEO Forum issued the STaR Chart, a self-assessment tool individual schools can use to gauge their progress toward integrating technology to improve education. The CEO Forum issued the first STaR Assessment, a benchmark measure of national progress toward integrating technology in education.

Year 2: Focusing on the issue of professional development, the CEO Forum Year 2 *School Technology and Readiness Report* called *Professional Development: A Link to Better Learning* (February 1999), includes a status report on educator professional development, an update of the STaR Chart to include new criteria for assessing individual school progress on professional development, and an update of the STaR Assessment.

Year 3: The CEO Forum will update the content section of the STaR Chart, report on the nation's progress in developing and integrating digital content, and update the STaR Assessment.

Year 4: In its final year, the CEO Forum will address the important question of how to measure the impact of technology on student achievement and educational outcomes as well as update the STaR Chart and STaR Assessment.



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